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NOVEMBER 30.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty members present.

On Heat and Chemical Action.—Prof. PERSIFOR FRAZER, Jr., stated that Prof. Hunt, in chemical and geological essays No. VII, "On Some Points in Dynamical Geology," p. 77, after speaking of his adoption of Babbage's and Herschel's hypothesis of an igneous centre, adds that Kefersbein rejects this hypothesis as unnecessary, and Joseph Le Conte proposes an intermediate view that heat from a molten centre invading the sedimentary intermediate layers may excite chemical activity, which in turn would augment the temperature. He concludes, "it is, however, I think, probable that any chemical processes which may be set up in the buried sediments for their conversion into igneous rocks and volcanic products would absorb rather than generate heat."

The mere conversion of silicates from the solid to the liquid, or, if it be possible, gaseous states, is not chemical action; and hence fusion or vaporization, which undoubtedly would lower the temperature by its great absorption of heat, cannot be referred to here, and it seems at first sight rather difficult to say what form of chemical action—except dissociation, if that can be called such—would absorb heat, or upon what phenomena this statement is based.

On the supposed Carnivora of the Eocene of the Rocky Mountains.—Prof. COPE remarked that animals which fulfilled the functions of the existing *Carnivora* were abundant in North America during the Eocene period. The Wahsatch beds of New Mexico have yielded remains of more than a dozen species, which ranged from the size of a weasel to that of a jaguar. Investigation into the structure of these shows that while they differ in minor points among themselves, they agree in possessing characters which distinguish them from the true *Carnivora*. I have already pointed out,¹ that, in the genera *Ambloctonus*, *Oxyæna*, *Stypolophus*, and *Didymictis*, the tibio-tarsal articulation differs from that of the existing *Carnivora*, and suggested that these forms might prove to be gigantic *Insectivora*. Further investigation has satisfied me that they cannot be included in the order *Carnivora*, and their systematic position proves to be of considerable interest.

A greater or less part of the cranial chamber is preserved in specimens of *Oxyæna forcipata* and *Stypolophus hians*. In these

¹ Systematic Catalogue of the Vertebrata of the Eocene of New Mexico, 1875, p. 7.

animals it has a long, narrow form like that of the opossum, and in the first named, where the interior form can be seen, it is evident that the cerebral hemispheres were small and narrow, and that the olfactory lobes were relatively large, and were entirely uncovered, projecting beyond the hemispheres.

In *Ambloctonus*, *Didymictis*, and three undetermined forms, the femur supports a third trochanter. In all the genera the ilium has a well-marked external anterior ridge, which continues from the acetabulum to the crest, distinct from the internal anterior ridge. The ilium has, therefore, an angulate or convex external face, as in *Insectivora* and *Marsupialia*, and does not display the usual expansion in a single plane of most of the placentals. In all the genera there is a strong tuberosity in the position of the anterior inferior spine, which is wanting in the *Mammalia*, excepting certain *Insectivora* and *Prosimiæ*,¹ although it marks the position of the origin of the rectus femoris muscle in all types.

The glenoid cavity of the squamosal bone is transverse, and well defined anteriorly and posteriorly, as in the *Carnivora*. Of the first series of carpal bones of the four genera named, I have been able to learn nothing, but in the genus *Synoplotherium* from the Bridger Eocene of Wyoming, which probably belongs to this group, the scaphoid and lunar bones are separate and not united as in the *Carnivora*.

The above characters point to the *Marsupialia* or the *Insectivora* as the proper location for the flesh-eaters under consideration; and the evidence is much more weighty in favor of the latter order as their true position. For in the genera *Oxyæna* and *Didymictis* the posterior part of the inferior border of the mandibular ramus is not inflected as in *Marsupialia*, nor are the anterior inferior iliac tuberosity and third trochanter seen in that order, while both exist in the *Insectivora*.

Cuvier describes² the tibia of *Carnivora* as follows: "Quant à la tête inférieure, tous les carnassiers se distinguent de l'homme par sa figure plus étroite du côté externe que le l'interne, et par sa division en deux fosses oblique, au moyen d'une arête arrondie qui répond à la partie de l'astragale. . . . Le phoque l'a cependant d'une forme très-particulière par l'excèsif aplatissement de sa moitié supérieure, et par sa facette particulière inférieure, qui est en concavité simple et peu profonde."

The astragalar articular face of the tibia in the genera above named is not divided into the two oblique fossæ by "a rounded crest which is applied to the groove of the superior pulley-shaped face of the astragalus." It is uninterrupted and more or less oblique in the transverse direction; always so at the posterior border. The inner malleolar process is produced downwards, and rests in a concavity on the inner side of the neck of the astragalus.

¹ See the figure of *Solenodon* by Peters, and *Chiromys* by Owen.

² Ossements Fossiles, vii. p. 112.

The astragalus, which I have seen in several of the species, presents a corresponding trochlear face. That is, instead of a groove, it presents an open angle upwards, which separates the superior from the oblique internal face. The superior plane is flat, but is interrupted on the posterior side by a groove. This groove is the posterior extremity of that which divides the superior face of the astragalus in the higher *Mammalia*, but here it contracts to a point and disappears next the fibular face just as it reaches the superior surface. The fibular face is vertical, and shares on its posterior part a large ligamentous fossa with the opposed part of the fibula. The distal end of the fibula is remarkably stout.

This structure finds its counterpart in the internal half of the astragalus of the opossum. The arrangement permits a rotary movement of the astragalus and thus of the whole foot, on the tibia, the fibula, with its fixed articulation with the astragalus, rotating on the tibia, as in the pedimanous *Marsupialia*. The flatness of the inner malleolus in some of the species indicates that the capacity for rotation was less in them than in others. This arrangement exactly reverses the extensive oblique fibulo-astragalar articulation seen in the opossum, the *Petaurista*, *Dasyurus*, etc. Prof. Owen, in describing the astragalus of the wombat (*Phascogomys*), says: "The upper articular surface for the tibia is as usual concavo-convex, the internal surface for the inner malleolus flattened, and at right angles with the preceding, but the outer articular surface presents a triangular flattened form, and, instead of being bent down parallel with the inner articular surface, slopes away at a very open angle from the upper surface, receiving the articular surface of the fibula so as to sustain its vertical pressure. * * * This form of astragalus is also characteristic of the Koala, Petaurists, Dasyures, and the Pedimanous Marsupialia."

In one species where the cuboid bones are preserved, it is evident that the distal end of the astragalus articulated with this as well as with the navicular bone, although the facet of the astragalus is single and continuous. As the extensive transverse distal astragalar face is characteristic of all the species where it is preserved, the contact of the cuboid and astragalus is probably common to all of this division.

The dentition of this group is consistent with its reference to the sarcophagous *Marsupialia* or to the *Insectivora*. It has, however, decided resemblances in the form of the molars, and in the deficiency in the number of the inferior incisors, to such genera of *Insectivora* as *Mythomys* and *Solenodon*, while in the large canines, it more nearly approaches *Sarcophaga* and *Carnivora*.

I propose to include the genera *Ambloctonus*, *Oxyæna*, *Stypolophus*, and *Didymictis* in a special division under the name of *Creodonta*. This division may be regarded as a suborder of the *Insectivora*. It is possible that the genus *Diacodon* Cope belongs here also; its species resemble *Chiroptera* in the inferior dentition,

and are of small size. The genus *Mesonyx*,¹ which I discovered in the Bridger beds of Wyoming, cannot be referred to the *Creodonta* as here constituted, since the trochlear face of the astragalus is completely grooved above as in the true *Carnivora*, and its distal end presents two distinct facets, one for the cuboid and the other for the navicular bones. It represents on this account a peculiar family, the *Mesonychidæ*.

To the *Creodonta* must be referred the genera *Pterodon* and *Palæonictis* of De Blainville, from the French Eocene. This author and Pomel placed them in the *Marsupialia*, but Professor Gervais remarks (*Geologie et Paleontologie Francaise*) that the evidence is insufficient for such a course. Here also doubtless belong supposed *Carnivora* from the Wyoming Eocene, stated by Marsh to be allied to the *Viverridæ*.

The remarkable type first introduced to the notice of paleontologists by Leidy, represented by the genera *Anchippodus*, *Ectoganus*, etc., has been looked upon as an order of *Mammalia* by Marsh, and termed the *Tillodontia*. He gives,² as its characters, the possession of claws, plantigrade feet with five toes, a third trochanter of the femur, and separate scaphoid and lunar bones. Also, that the dentition is characterized by "molars of the ungulate type," small canines, and large scalpriform incisors in both jaws, faced with enamel and growing from persistent pulps as in the *Rodentia*. He says this order "seems to combine characters of the orders of carnivores, ungulates, and rodents."

Except in the dentition, the definition above given applies to the *Creodonta*; and an analysis of the dentition shows so many points of resemblance as to render it probable that they pertain to the same order of *Mammalia*. Also, except in the dentition, the characters given by Prof. Marsh do not differ from those of the *Insectivora*. The structure of the superior molars is not inconsistent with the same order, and the small canines and large incisors are even more like those of most *Insectivora* than are *Creodonta*. The singular form of these incisors, and their growth from persistent pulps, is rather characteristic of *Rodentia*. The transverse or tubercular premolars also distinguish this group from both the *Creodonta* and the true *Insectivora*. The definitions of the order and sub-orders will then be as follows:—

INSECTIVORA.—*Mammalia* with small cerebral hemispheres which do not cover the olfactory lobes, nor the cerebellum; with numerous clawed digits, and a third trochanter of the femur; with a transverse glenoid cavity for the mandible.

Superior incisors normal, not growing from persistent pulps; canines large; premolars compressed. Astragalus not grooved above, articulating with the cuboid as well as the navicular; five toes on the hind foot;

Creodonta.

¹ Ann. Rept U. S. Geol. Surv. Terrs., 1872, p. 550.

² Amer. Journ. Sci. Arts, 1875, 231.

Superior incisors large, growing from persistent pulps, and without enamel on the sides; superior canines small when present; premolars wide or tubercular; *Tillodonta*.

These suborders of the order *Insectivora* do not differ among themselves more than do those of the *Marsupialia*, and constitute a series of parallels with them. Thus the *Creodonta* resemble the *Sarcophaga*, the *Insectivora vera* the *Entomophaga*, and the *Tillodonta* the *Rhizophaga*, typified by *Phascalomys*.

The genera of the *Creodonta* differ as follows:—

I. First and third inferior true molars without internal cusp. Last superior molar longitudinal; last inferior molar carnassial; *Ambloctonus*.

II. Inferior carnassials with interior tubercle; no tubercular molar; last superior molar transverse.

Three tubercular carnassials;¹ *Stypolophus*.

Two tubercular carnassials; *Oxyæna*.

III. Inferior carnassial with interior tubercle; a tubercular molar.

One tubercular carnassial; *Didymictis*.

The number of toes on the hind foot cannot be certainly stated in all the genera, but in *Stypolophus hians* and another species there were probably five, the inner being of reduced size. There is present in those species an ento-cuneiform bone which resembles that of *Canis*; it is compressed, with one truncate concave terminal facet, and an internal oblique one at the opposite and proximal extremity. The form of the truncate articular face of the distal end indicates the existence of an inner metatarsal bone of moderate proportions, which probably supported a small hallux. This thumb could not be opposable as in the opossum.

In general appearance the *Creodonta* differed from the *Carnivora*, in many of the species at least, in the small relative size of the limbs as compared with that of the head, and in some instances, as compared with the size of the hind feet. The feet were probably plantigrade, and the posterior ones capable of some degree of rotation. The probable large size of the rectus femoris muscle indicates unusual power of extension of the hind limb. They were furnished with a long and large tail. Probably some of the species resembled in proportions the *Mythomys* and *Solenodon*, now existing in Africa and the West Indies, but they mostly attained a much larger size.

J. B. Knight, Elliston P. Morris, R. Shelmerdine McCombs, M.D., John C. Boyd, M.D., U. S. N., and Eli K. Price, Esq., were elected members.

Prof. William Henry Flower, F.R.S., of London, Dr. Albert

¹ For the meaning of these expressions, see Syst. Cat. Eoc., New Mexico, 1875, p. 6.

Günther, of London, Prof. St. George Mivart, F.R.S., of London, N. S. Maskelyne, F.R.S., of London, and Prof. George Rolleston, F.R.S., of Oxford, were elected correspondents.

The Committee, to which was referred a paper entitled "A Descriptive Catalogue of Scalidæ of the West India Islands," by Dr. O. A. L. Mörch, reported in favor of its publication in the Journal.

The Committees to which they had been referred recommended the following papers to be published :—